

On page 2 of the Office Action, Claims 80-82, 86 and 87 have been rejected under 35 U.S.C. § 112, second paragraph, by the Examiner as being indefinite. In particular, the Examiner alleged that, in Claims 80-82, 86 and 87, it is unclear what is required by “(mol/g-carrier) per unit weight of a carrier.”

In response, Applicants have amended Claims 80-82 to delete “per unit weight of a carrier.”

In view of foregoing, Applicants respectfully submit that the present claimed invention now more clearly complies with the requirement of 35 U.S.C. § 112, second paragraph. Accordingly, withdrawal of this rejection is requested.

On pages 2-3 of the Office Action, Claim 76 has been rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent 4,847,231 to Grätzel *et al.* (Grätzel ‘231).

It is asserted that Grätzel ‘231 discloses a catalyst having a mixture of Ru and RuO₂ highly dispersed on a support. Additionally, referring to Example I of Grätzel ‘231, it is further asserted that the support used in Grätzel ‘231 is TiO₂ with 90% anatase and 20% rutile.

In view of foregoing, it is concluded that the catalyst of Grätzel ‘231 anticipates the claimed product.

Applicants respectfully traverse this rejection for the following reasons.

The present invention is directed to a supported ruthenium oxide catalyst having high catalytic activity for producing the desired compound of chlorine by oxidizing hydrogen chloride. More specifically, the present invention, as defined in amended Claim 76, is directed

to a supported ruthenium oxide catalyst obtained by supporting ruthenium oxide on a titanium oxide carrier containing not less than 80 % by weight of rutile titanium oxide.

In contrast, Grätzel '231 teaches a process for the direct formation of methane from carbon dioxide and hydrogen by heterogeneous catalytic gas phase reaction, which is much different from producing chlorine. Grätzel '231 merely discloses a catalyst used in the formation of methane.

Applicants respectfully submit that Grätzel '231 does not teach or suggest a catalyst for producing chlorine by oxidizing hydrogen chloride. Moreover, Applicants respectfully submit that Grätzel '231 does not disclose a supported ruthenium oxide catalyst, as presently claimed, on a titanium oxide carrier containing not less than 80 % by weight of rutile titanium oxide.

In view of the foregoing, Applicants respectfully submit that Grätzel '231 does not anticipate the presently claimed catalyst. Accordingly, withdrawal of this rejection is requested.

On page 3 of the Office Action, Claims 76-79 have been rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 4,585,540 to Beer *et al.* (Beer '540). Also, on page 7 of the Office Action, Claims 76-79 and 83-85 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Beer '540.

Beer '540 is relied upon to assertedly disclose "a porous high surface area composite electroconductive catalytic material comprising a porous preform host catalytic matrix and a subsequently-applied additional catalyst dispersed throughout and supported by the preformed matrix, wherein the preformed matrix is a mixed catalytic material comprising at least one platinum-group metal oxide mixed intimately with at least one non-precious metal oxide in a

porous high surface area support structure (referring to claim 1 and claim 9, item (a)).”

Referring to Example 1 and sample #59 of Beer ‘540, it is asserted that “ruthenium-titanium oxide is disclosed as the mixed catalytic material” and “the preformed matrix is considered the same as the claimed catalyst.”

Additionally, referring to Claim 2 of Beer ‘540, it is asserted that “the porous matrix consists essentially of mixed crystal material of rutile structure.” Beer ‘540 is also relied upon to assertedly disclose the preformed matrix having “a single crystalline phase of rutile structure (note paragraph bridging column 5-6 [*sic*])” and “the titanium oxide used being in rutile form.”

With regard to Claims 83-85, it is asserted that “any difference imparted by the product by process limitations would have been obvious to one having ordinary skill in the art at the time the invention was made because where the examiner has found a substantially similar product as in the applied prior art the burden of proof is shifted to the Applicant to establish that their product is patentably distinct.”

Applicants respectfully traverse this rejection for following reasons.

In the first place, Applicants respectfully point out that Beer ‘540 is related to a porous high surface area composite electroconductive catalytic material which is particularly suitable for use in electrolytic processes. Applicants also respectfully submit that Beer ‘540 does not teach or suggest that the porous high surface area composite electroconductive catalytic material is suitable for producing chlorine by oxidizing hydrogen chloride.

While it is asserted that the preformed matrix is considered the same as the presently claimed supported catalyst, Applicants respectfully submit that the preformed matrix as disclosed

in Beer '540 is not identical to the supported ruthenium oxide on titanium oxide, as presently claimed.

According to claim 1 and claim 9 in Beer '540 which are referred to by the Examiner, the preformed matrix is a mixed catalytic material comprising at least one platinum-group metal oxide mixed intimately with at least one non-precious metal in a porous high surface area support structure. As described in the paragraph bridging column 4-5, a mixed catalytic material is produced by codeposition of the components. That is, the preformed matrix disclosed in Beer '540 is the mixture of at least one platinum-group metal oxide mixed intimately with at least one non-precious metal, and Beer '540 does not disclose supported platinum-group metal oxide on non-precious metal, much less disclose supported ruthenium oxide on titanium oxide.

It is also asserted that Beer '540 discloses the use of titanium oxide in rutile form. Applicants, however, submit that what Beer '540 discloses is that the mixed crystal materials, not supporting material, form a single crystalline phase of rutile structure. Beer '540 does not disclose or suggest that the supporting material such as titanium oxide used in the presently claimed catalyst has a single crystalline phase of rutile structure.

Moreover, Applicants respectfully submit a Declaration pursuant to 37 C.F.R. § 1.132 executed by Mr. Kohei Seki, which accompanies this reply, to demonstrate the difference between the presently claimed catalyst and a mixed catalyst disclosed in Beer '540, and also the unobviousness of the present claimed invention. In Experiment 4 of the Declaration, Sample E is supported ruthenium oxide catalyst as presently claimed, and Sample F is mixed catalyst of

ruthenium oxide and titanium oxide similar to Sample #54 of Beer '540. Experiment 4 clearly demonstrates that Sample E has much higher catalytic activity than Sample F.

Accordingly, Applicants respectfully submit that the present claimed catalyst is not taught or suggested by the mixed catalyst disclosed in Beer '540.

On pages 4-5 of the Office Action, Claims "76-83-85" have been rejected under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over Grätzel '231. Additionally, on page 5 of the Office Action, Claims 76-87 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Grätzel '231.

Specifically, it is asserted that for Claims 83-85, "any difference imparted by the product by process limitations would have been obvious to one having ordinary skill in the art at the time the invention was made because where the Examiner has found a substantially similar product as in the applied prior art the burden of proof is shifted to the applicant to establish that their product is patentably distinct."

It is also asserted that "Grätzel '231 further discloses that in the case of TiO_2 , mixture of anatase and rutile forms work very well as support material, however, pure anatase and pure rutile have also yielded good results when used in conjunction with mixed ruthenium as a catalyst (note column 3, lines 26-31)." Additionally, Grätzel '231 is relied upon assertedly suggest at least some "OH" remaining in the catalyst because KOH is used during the process of making the catalyst.

In view of the foregoing, it is concluded that "it would have been obvious to one of ordinary skill in the art at the time of the invention was made to optimize the process condition in

Grätzel '231 and in turn the amount of "OH" in the catalyst to obtain the best results, *i.e.*, a catalyst suitable for hydrogenation."

Applicants also respectfully traverse this rejection for following reasons.

As discussed above, Applicants respectfully submit that Grätzel '231 does not disclose a supported ruthenium oxide catalyst on a titanium oxide carrier containing not less than 80 % by weight of rutile titanium oxide, as presently claimed. Accordingly, Applicants respectfully submit that the catalyst of Grätzel '231 does not anticipate the presently claimed catalyst. Additionally, as mentioned above, Grätzel '231 is related to a process for the direct formation of methane from carbon dioxide and hydrogen. That is, as the Examiner acknowledged, Grätzel '231 is related to the hydrogenation of carbon dioxide. On the contrary, the presently claimed invention is directed to a catalyst suitable for the oxidation of hydrogen chloride which is much different from the reaction disclosed in Grätzel '231. Grätzel '231 does not teach or suggest that the catalyst used in the process of the hydrogenation of carbon dioxide is also suitable for the oxidation of hydrogen chloride.

Grätzel '231 merely discloses that the use of pure anatase and pure rutile forms of TiO_2 as support material have yielded good results when these are used in conjunction with mixed ruthenium as a catalyst for the hydrogenation of carbon dioxide. There is no description or no suggestion that pure anatase or pure rutile of TiO_2 as support material have yielded good results in the oxidation of hydrogen chloride. Additionally, Applicants respectfully submit that the use of pure anatase of TiO_2 does not necessarily have a good result, as shown in Examples 4 and 14 of the present specification.

Moreover, Applicants respectfully submit that the above-discussed Declaration also demonstrates the superiority of the not less than 80% rutile form of TiO_2 over 20 %. *See*, Table 1 of the Declaration. Table 1 demonstrates that the life of supported ruthenium oxide on titanium oxide having not less than 80% rutile form is longer than that of supported ruthenium oxide on titanium oxide having 20% rutile form. Grätzel '231 does not teach, suggest or appreciate such superiority of supported ruthenium oxide on titanium oxide having 100% rutile form.

While the Examiner asserts that, referring to Example I, Grätzel '231 fairly suggests at least some "OH" would remain in the catalyst, Applicants respectfully submit that the Examiner's position is incorrect. In Example I, 0.1 M KOH was added in order to increase the pH to 4.5, which is still acidic. However, Applicants respectfully submits that this teaches away from the presence of OH ions in the catalyst since the reaction solution is acidic.

In view of foregoing, Applicants respectfully submit that Claims "76-83-85" are not anticipated by, or in the alternatively, obvious over Grätzel '231 and that Claims 76-87 are not obvious over Grätzel '231.

On page 6 of the Office Action, Claims 76-87 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,001,768 to Buysch *et al.* (Buysch '768).

It is asserted that Buysch '768 discloses a supported catalyst containing a platinum, a platinum metal compound or a complex containing a platinum metal compound on a support comprising one or more oxides of metals Ti, V, Mn, Cr, Fe, Co, Ni, Cu, La, Nb, Mo, Pb, the rare earth metals having the atomic numbers from 58-71 and the actinides having the atomic numbers

89-92. It is further asserted that, referring to column 3, lines 56-60, "the support can be TiO₂, preferably in the rutile form," and that, referring to column 4, lines 34-36, "the platinum metal can be Pd, Pt, Ir, Ru, or Rh." Buysch '768 is also relied upon by the Examiner to suggest that there would at least be some "OH" remain in the catalyst because Buysch '768 discloses that it is possible to fix one or more platinum metals by precipitation with a base as NaOH, LiOH, KOH etc. Additionally, it is asserted that a solution of one or more of the platinum metals specified can be applied to the catalyst support, drying, calcining, and that the calcining step fairly suggests that the platinum metal is present in the catalyst in an oxide form.

Applicants also respectfully traverse this rejection for the following reasons.

Applicants respectfully submit that Buysch '768 is directed to supported catalysts containing a platinum metal and their use in processes for preparing diaryl carbonates by reaction of aromatic hydroxy compounds with carbon monoxide and oxygen. Buysch '768 does not teach or suggest that a catalyst as disclosed therein can be used in a process for producing chlorine by oxidizing hydrogen chloride. More specifically, Buysch '768 does not, as the Examiner acknowledged, teach or suggest a supported ruthenium oxide on the titanium oxide having rutile form and its use in the process for producing chlorine by oxidizing hydrogen chloride.

Additionally, Applicants respectfully submit that Buysch '768 does not teach, suggest or appreciate the superiority of titanium oxide having not less than 80% rutile form, as discussed above. In particular, Applicants respectfully submit that there is no motivation to select the combination as presently claimed from the embodiments of Buysch '768, because Buysch '768

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does not teach or suggest the presently claimed catalyst, nor suggest that the catalyst disclosed in Buysch '768 is suitable for producing chlorine by oxidizing hydrogen chloride.

In view of the forgoing, Applicants respectfully submits that the present claimed invention is not anticipated or rendered *prima facie* obvious by the cited prior art.


All claims should now be in condition for allowance. Early indication of allowability is respectfully requested. Should any minor points remain prior to issuance of Notice of Allowance, the Examiner is requested to telephone the undersigned at the below listed telephone number.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

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Applicant hereby petitions for any extension of time which may be required to maintain the pendency of this case, and any required fee, except for the Issue Fee, for such extension is to be charged to Deposit Account No. 19-4880.

Respectfully submitted,


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APPENDIX

Marked up version of the claims

IN THE CLAIMS:

Claim 76. (Amended) A supported ruthenium oxide catalyst obtained by supporting on a titanium oxide carrier containing not less than [20] 80 % by weight of rutile titanium oxide.

Claim 80. (Amended) The catalyst according to claim 76, wherein titanium oxide containing an OH group in an amount of 0.1×10^{-4} to 30×10^{-4} (mol/g-carrier) [per unit weight of a carrier] is used as the carrier.

Claim 81. (Amended) The catalyst according to claim 76, wherein titanium oxide containing an OH group in an amount of 0.2×10^{-4} to 20×10^{-4} (mol/g-carrier) [per unit weight of a carrier] is used as the carrier.

Claim 82. (Amended) The catalyst according to claim 76, wherein titanium oxide containing an OH group in an amount of 3×10^{-4} to 10×10^{-4} (mol/g-carrier) [per unit weight of a carrier] is used as the carrier.